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A Study of The Relationship Existing Between Certain Insects and Some Native Western Kansas Forbs and Weedy Plants

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A STUDY OF THE RELATIONSHIP EXISTING BETWEEN CERTAIN INSECTS AND SOME NATIVE WESTERN KANSAS FORBS AND WEEDY PLANTS

being

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by

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Purpose of Study

To the casual observer perhaps no sight could be more commonplace than that of an insect alighting upon a Kansas sunflower. But the relationship which exists between plant and insect is a matter which is often unknown even to the specialist. And yet a lack of understanding of these relationships has at times resulted in inconvenience,loss and even in calamity. To determine the relationship which certain insects bear to some of our native western Kansas forbs and weedy plants is the purpose of this study.

Scope of Study

The subjects of this investigation are those insects which spend at least a part of their lives beneath the epidermis of the root,stems,or leaves or within the inflorescence,fruits,or galls produced by the plants. Insects which may consume internal parts as well as external but which do not at some time inhabit the plant body or its products are excluded from consideration.

History of Study

During the summer of 1941 in connection with a course in Plant Ecology a problem presented itself to determine the fate of the seeds produced by the white beard-tongue, (*Pentstemon albidus*). The final tabulation of results in the study showed that insects account for approximately 50 per cent of the seeds produced within two months after flowering. An investigation was then begun to determine which insects were probably most effective in destroying the seeds. Large numbers of plants were dug and carefully examined. It was found that two insects commonly inhabit the seed capsules. These insects were studied in some detail and their life cycles observed. This proved so interesting that a study of additional native plants and weeds was determined upon in order to ascertain if possible which insects most commonly affect internal parts of these plants.

Procedure

In the case of each plant a superficial study was made in the field. Among large numbers of plants examined those were selected for special examination and dissection which gave indications of insect infestation. These were dug and taken to the laboratory and completely dissected. Each root, stem, petiole, leaf, flower, fruit, and gall was carefully ex-

amined and all parts which might harbor insects were fully dissected. Insects found were kept and cultured for further observation. It was found extremely difficult to keep certain burrowing types alive because of the effects of desiccation in open containers and because of the attacks of molds and other fungi when containers were kept closed.

Plants were collected from 15 different locations in western Kansas all within a radius of about 80 miles to the east,north,west,and southwest of Hays.Plants were obtained from two areas through the coo eration of Dr.F.W. Albertson and John Launchbaugh.

Acknowledgments

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PENTSTEMON ALBIDUS NUTT.

The white beard-tongue,(Pentstemon albidus),is listed by Albertson (1) as a forb of secondary importance in the mixed prairie. In a study preliminary to the present problem the plant was found to possess and increase potential of four thousandfold yet it never attains the status of a dominant in its native habitat.

A careful examination of July,16,1941 of 25 plants bearing 218 seed capsules showed 109 of them to have been damaged by insects. Three species of insects were discovered feeding upon the seeds within the capsules. The first,found only in a single capsule,on June 24,1941 is probably a species of Noctuidae. A dark spot was observed on one side of the capsule and upon opening it was found that one carpel was filled with fecal pellets while the pupa occupied the other carpel. A fine silken web separated the two carpels. The pupa was dark brown,5 mm in length and 2 mm in diameter. The head was placed toward the apex of the capsule (Fig.4).

The second insect,found on June 14,1941,was in the larval stage. It was a waxy,legless grub 4 mm long and 1.7 mm wide,with a funnel-like proboscis at the cephalic end (Fig.5). This larva pupated on June 20 becoming a dark brown pupa slightly less than 4 mm in length and

slightly more than 1 mm in width (Fig.6). In 204 capsules opened 29 larvae or pupae of this species were found. Some of the dwarfed capsules contained pupae of this insect. One capsule of normal size contained two. In most cases one insect was found to consume all of the seeds of a single normal capsule.

Since none of these insects emerged through the months of June and July four pupae were placed in a refrigerator on August 2 and kept until August 3 at a temperature of 35 to 40 degrees Fahrenheit. Then they were removed but they did not emerge until May 1942. On June 2, 1942 the last of the living insects emerged, those treated in the refrigerator being neither first nor last to appear.

The adult, Phytomyza chrysanthemi (Kowarz), is a small gray fly 4 mm long, the wings making up about half this length and 1.5 mm wide.

Another insect found within the capsules is a plume moth probably of the genus Adaina, which was found in 51 of the 204 capsules. In 71 additional capsules perforations and fecal pellets indicated occupancy by this species. The larva of this insect is dusky red above and light green below with greenish lateral lines on each side. There is a double row of spines transversely on each segment. The head is yellowish. The larva is 12 mm in length and slightly more than 1 mm in width. When ready to pupate the larva cuts an emergence hole to the

the outside. This emergence hole is usually near the petiole, though at times it may be near the apex of the capsule. Occasionally two larvae are found to occupy a single capsule and perhaps at times one larva consumes the seeds of two capsules. In 4 capsules a hole was found cut through the sepals but not into the capsule, indicating that the cutting was done from the outside. One larva taken from a capsule in which all of the seeds had been consumed was placed in another capsule in which a small opening had been made. The larva at once began to feed and continued until all the seeds had been consumed, after which it emerged and pupated normally.

After emerging the larva spins a carpet of silk about 15 mm in length and 2 mm in width. This silk is usually attached to the stem of the plant. The insect then attaches itself near the anal end so that it comes to lie on silk throughout its entire length. When disturbed the chrysalis slaps back violently with its anterior part, thus forming a reverse letter C, while keeping only its posterior segments in contact with the silk. In culturing vials placed on their sides the silk was laid down along the concave inner surface but in a definite vertical line as though on a stem. While this curved surface would seem to offer a rather uncomfortable situation for the chrysalis, several specimens attached themselves in this position.

The chrysalis is usually reddish brown or greenish,11 mm in length (Fig.2). The first of these larvae pupated July 7 and emerged as an adult on July 14,1941. Other moths emerged in from 2 to 8 days after pupating,the usual time being 7 days.

The adult moth is light tan,the wings marked with darker lines. The forewings are bifid,cleft from about 3/4, the hind wings are trifid. The wings are 15 to 17 mm in expanse (Fig.3). Numerous adults were kept in vials but no eggs were laid nor was copulation observed at any time.This would lead to the belief that only one sex,probably the male,was represented and that the other sex would probably be found in another situation. Most of the moths lived from 8 to 9 days after emergence.

This species of Adaina and Phytomyza chrysanthemi undoubtedly represent potential checks upon(Pentstemon albidus),the Adaina being found in exactly 50 per cent of the capsules opened and Phytomyza chrysanthemi in 14 per cent of the capsules.

VERNONIA BALDWINI TORR,

One of the principal forbs of the Big Blue Stem habitat found commonly in low,deep soiled ravines,where it overtops most of the grasses,is the ironweed,(Vernonia baldwini). It is a plant which tends to spread rapidly under heavy grazing

and thus it becomes an indicator of overgrazed conditions.

Schwitzgebel and Wilbur(12) carried on a study of the coleoptera associated with ironweed,(Vernonia interior) Small,which is listed by Gray as a variety of (V.baldwini) Torr. Their study was begun in June 1939 and continued through June 1941. They list a tota l of 47 species of coleoptera associated in some way with this plant,in the vicinity of Manhattan,Kansas.

In the present study 32 plants were collected and dissected. They were taken from five different localities all in Ellis County. At one place,along the Smoky Hill River south of Ellis,the plant was not to be found. Two miles north of the river,however,Vernonia began to appear in the pastures. Plants taken from this area were entirely free from insects,while Vernonia in most other locations was at the same time being attacked by a host of insects.

In the roots of this plant a borer was found in four cases. This larva when mature is 18 mm in length and 7 mm in width. Its body consists of 11 segments with three pairs of thoracic legs and 4 pairs of abdominal legs. Each segment except 2 and 3 bears a dark spiracle spot. The head is light brown with strong,black mandibles. The prolegs are on segments 6 to 9. This is evidently a lepidopterous larva but it has not yet pupated. It was discovered in the roots on August 4,1941 and again on June 18,1942.

On June 30 this specimen left the root and entered the soil where it remains as a larva (July 8).

In the stems numerous burrows were found (Plate 8). The most prominent borer, of which 15 individuals were found, is probably the coleopteron, Ataxia hubbardi (Fisher) which is described by Schwitzgebel and Wilbur. No individuals of this species were reared to maturity. The larva is 15 to 18 mm in length and 3 mm in diameter. It is whitish in color with a brown head. It has 3 pairs of thoracic legs but no abdominal legs. The damage done by this insect is shown to be largely confined to the pith, the insect therefore did not seem to be particularly harmful to the plant.

In the leaves of three plants the mines of leaf miners were detected on July 31, 1941 but no trace could be found of the insect, which had probably pupated and emerged previous to this date. The mine was serpentine, visible from both sides of the leaf, and littered with numerous pellets. On June 21, 1942 thirty additional leaves were found containing mines but these also were deserted.

Among the 1135 seed-bearing heads that were dissected 4 different insects were found pupating among the seeds. In every case the seeds had been entirely consumed. Three types of insects emerged from pupae found attached to the outside of the involucre, the seeds bearing evidence of infestation. The 4 species found inside the head are all

Hymenoptera, some of them probably parasitic upon others. They are two species of Eurytoma, Zagylptonotus schwarzi (Cwfd.), and Pachyneuron mucronatum (Girault). The Eurytomidae, being commonly phytophagus, are probably responsible for the greatest destruction of the seeds. Pachyneuron species, being parasites according to Essig (7), this species is probably parasitic upon the Eurytomidae.

The three insects found pupating on the outside of the involucre included another species of Eurytoma with longer antennae each segment of which bears a turt of bristles. The other 2 insects pupating on the outside are diptera, Leucopis griseola (Fallén), and Neaspilota alba (Loew). The first named is mentioned by Essig (7) as a very efficient destroyer of aphids of the stems and leaves of plants. This fact might throw this insect outsid the scope of the present paper. Curran (6) says the larvae of the family Trupaneidae commonly live in the seeds and fruits of plants some live in the heads of thistles, some make galls on the goldenrods, and still others are leaf miners. It is probable therefore that Neaspilota alba was responsible for the damage to the seeds.

Termites, probably Reticulitermes claripennis (Banks) were discovered in stalks of the previous season's growth.

The most effective insects inhabiting (Vernonia baldwini) in the present study were the insects eating the seeds. In

one count of 186 heads from 4 areas it was found that 59.6 per cent of the seed had been destroyed.

LIATRIS PUNCTATA HOOKER

According to Albertson(1) one of the characteristic forbs of the little blue stem habitat, the sunny slopes and the rocky outcrops, of the mixed prairie is the blazing star, (Liatris punctata). Known also as the Kansas gay feather this plant adds a flash of purple to the browning autumnal landscape. It is also prominent in the short grass habitat of the flat hilltops.

Many plants of this species were examined in the field and 65 plants bearing 277 stems were collected in 9 different locations of western Kansas. These plants were carefully dissected and only 10 insects, of 3 species, were found. Of these 8 emerged from what appeared to be egg-like pupae inserted into the stem some six or eight inches above the surface of the ground. These egg-like structures were found quite frequently in both(L. punctata)and (Ratibida columnaris) Sims. Minute punctures produce spots on the outside of the stem betraying the presence of these structures. The spots are so small that they would probably escape notice but for the fact that a series of them is usually placed at regular intervals of from 1 to 3 mm for a distance of 1/2 to 3/4

inch along the stem.

Under the microscope these punctures appear as gaping wounds with the epidermal tissue bulging and torn around the puncture. The entire punctured area is usually somewhat discolored. Dissecting the stem revealed small cellulose-like sacks filled with a fluid of orange color. Whenever these were exposed by dissection of the stem they were soon desiccated. One stem which contained a series of them was not dissected but when 6 adults emerged it was not known definitely whether or not they had actually emerged from these egg-like structures. On June 25 a stem was dissected and a series of these structures found but two of them were dark in color and resembled pupae from which an adult was about to emerge. When the adults appeared two days later they were found to be wasps .8 to 1 mm in length. Both the thorax and abdomen are brilliant green. The legs are light yellow. The antennae are inserted below the middle of the face. It is believed that these insects are of the family Elachteridae.

A second insect appeared from what seemed to be the pupa of dipteron. Six pupae were discovered on November 20,1941. The adult emerged from this pupa on July 1,1942. It is a small wasp probably of the family Eupelmidae.

A third insect reared from the stems is another Chalcid

probably of the family Mymaridae. It is a minute, dark colored wasp with long legs, long antennae, and linear hind wings which are pedunculate at the base.

None of these insects could be shown to be seriously affecting the plant body of (L. punctata) nor to be interfering to any appreciable extent with seed production.

GUTIERREZIA SAROTHRAE (PURSH) BRITTON & RUSBY

Among the prominent plants of the Buchloe Bouteloua habitat (1) we find the gutierrezia, (Gutierrezia sarothrae) which extends its roots from 4 to 5 feet into the soil. The plant, which is seldom more than ten inches in height, is covered in fall with myriads of small yellow flowers. The tough stems which grow from a woody base remain green far into the winter and in spring give rise to new shoots.

Of this species 213 plants were carefully examined on June 18, 1942 and found to bear 33 bud galls. One plant bore 21 galls of this year's growth and 3 on the growth of a previous year. On November 7, 1941 thirteen plants were collected and dissected. On June 22 and June 25 respectively 11 and 10 plants were dissected. All of these plants were taken from the college pasture except those collected on June 25 which were secured at Hoxie. These plants bearing 798 stems, contained no living insects in any other internal

part except a larva in one root. When discovered this larva too was desiccated. The galls found on June 18, 1941 appear to be those of Rhopalomyia gutierrezia (Ckll.) but at this time (July 12) none of them have as yet emerged. The gall is is a capsule-like bud gall 8 mm long and 4.5 mm in diameter.

SOLIDAGO CANADENSIS (L.)

The goldenrod, (Solidago canadensis) is one of the rarer composites of the prairie being found commonly only along the streams of western Kansas.

The goldenrods have been frequently studied by students of gall makers. Stebbins (13) lists 17 galls produced on various members of this group. Felt (8) lists 53 galls produced upon the various members of the genus. In the present study 41 plants were collected at 5 locations in Ellis County from August 1941 to June 8, 1942. These plants were found to contain insects of 4 gallmaking types.

Gnorimoschema gallaesolidagenis (Riley) was found to be commonly infesting the plant. In one count of 136 stalks, on August 1, 1941 thirty five galls of this species were found. (Plate 3). The same stalks bore 42 galls from which Zatropis nigroaenus (Ashmead) and Apostocetus americanus (Ashmead) were reared. The former pupated on August 7 and emerged on August 9, 1941. A. americanus was found in the

pupal state on August 12 and emerged on August 13. In six cases apical rosette galls were found but the occupants were not successfully reared. Felt (9) lists 15 species of insects which produce such galls and several inquilines and predators that might also inhabit the galls.

In Plate 3 the work of several leaf miners may be detected. Their work was frequently encountered but none of the insects was found in the mines.

A species of Ceroptres was taken in the pupal stage attached to a terminal bud. According to Essig (7) this wasp has been reared from various galls.

None of the insects noted in this investigation seem appreciably to injure the plants except the rosette gall which usually prevented the normal flowering, and the apical bud gall which destroyed the growing tip of the branches.

SIDERANTHUS SPINULOSUS (PURSH) SWEET

From 9 areas within a radius of 65 miles of Hays 376 stems of (Sideranthus spinulosus) bearing 1355 heads were collected. This plant, which according to Albertson is another prominent forb of the short grass habitat seems to be affected principally by a single species of insect. Practically every seed had been destroyed in 662 of the

heads. The wasp responsible, Eurytoma neomexicana (Gir.) destroys the seed and then pupates in the receptacle among the pappus. The puna is slightly less than 3 mm long. Its color is pale yellow to whitish. The adult wasp is black with pale brown to yellowish legs and black antennae.

This wasp had damaged 55 per cent of the seed heads. It was found in every location except one. At this place, about 10 miles north of Quinter, the vegetation had suffered severely from dust. The two plants found in this location had 33 stems but only 7 heads were in bloom when the plants were taken on August 7. Undoubtedly this insect was effective as a check upon (Sideranthus spinulosus).

ASTER MULTIFLORUS AIT.

The many flowered aster, (Aster multiflorus) as the name indicates is one of our most prolific asters, being covered with hundreds of small white blossoms from early September until the snow covers it. As a result it has a tendency to become a pest, invading lawns, fence-rows, and vacant areas where its perennial root makes it somewhat difficult to eradicate.

Among the insects that affect this plant Felt (8) lists one lepidopterous insect invading the roots and Stebbins (12) describes galls induced by two hymenopterous insects. Neither of these was discovered in the

present investigation but a gall similar to one described by Stebbins commonly affects the plant in this area.

This globose to ovate gall is polythalamous, 4 mm to 7 mm in length and 3 mm to 5 mm in width. The gall is green, densely covered with white pubescence. Of these galls 127 were collected and cultured. Two types of insects emerged from this gall. In the case of the one insect the gall splits at maturity for some distance across the apex so that the occupants emerge without biting their way out. This gall gives rise to a midge, the pupa of which is 2.5 mm in length with a thick, red, abdomen. The genital segments are attenuate. One adult emerged on August 14, 1941, others were observed to emerge during July 1942. The adult midge of the family Itonididae is 3 mm long with a wing expanse of 6 to 7 mm. The abdomen is red, the genital segments attenuate as in the pupa.

From a gall which is indistinguishable from the foregoing with the exception that it was not split when the insects emerged a wasp, Pseudotorymus sp. was found biting its way out on August 12, 1941. Another of this species emerged on August 14 and numerous others throughout the month both males and females being common. Seven of the same species emerged from June 24 to July 2, 1942 but these were all females.

During the month of June 226 plants were carefully examined and 65 plants dissected. These yielded no other insects except those contained in 27 galls. During the month of August the galls became more numerous, 28 galls having been found on a single plant (Plate 1).

Considerable differences in the degree of infestation were noted in different localities. In one place 97 plants bore some 20 galls while one block away some 40 plants bore not a single gall. The author believes that these insects are potential checks upon Aster multiflorus but that they are not at present seriously affecting the plant. Since they commonly induce galls to grow from the terminal bud effectually hinder seed production by a heavy infestation as in the plant in plate 1.

LEPTILON CANADENSE (L.) BRITTON

One of the most common weedy plants of the mixed prairie is the mule's tail,(Leptilon canadense) which is to be found from the deepest ravines to the hilltops. It is abundantly found along fence-rows,roadsides,and waste land.

Specimens of this plant were collected from three locations near Hays and from four other areas of western Kansas. A total of 147 plants examined,21 completely dissected and many dissected in part yielded no insects affecting internal parts.

ECHINACEA ANGUSTIFOLIA DC.

The purple cone-flower, (Echinacea angustifolia) is perhaps as hardy as any plant considered in the present study. Its coarse exterior and its long taproot fit it well for the rigors of the prairie.

The 204 plants of this species that were dissected bore 351 heads, 152 of which were infested by a larva which seems to hatch from an egg inserted some six to eight inches below the head. The larva drills upward through the stem to enter the basal disk, which it hollows out. It then drills through to the developing seeds, which it proceeds to devour, returning to the basal disk to lodge when not feeding. This larva is of a pinkish color, plump, and 7 mm long. The head is brown. The body has 12 segments with no abdominal legs, but with 6 thoracic legs being present. This would indicate coleopteron but none of the larvae has as yet pupated under observation in the present study. Although dozens of larvae have been kept for extended periods of time they have either died or remained in the larval stage. If kept in the open air they tend, after the burrow has been opened, to desiccate. However when they are placed in a container to keep them humid, molds develop and destroy the insects. Several specimens taken in November, 1941 are still alive (July 8) but they remain in the larval state.

Another insect cultured from this plant is a hymenopteron, Microbracon helianthi (Muesebeck), the pupa of which was found among the seeds. This wasp is dark brown with smoke colored wings 4.5 mm in length and has a wing expanse of 9.5 mm. The head is black and bears moderately long antennae.

A coleopterous larva was found in two plants. It had eaten a large portion of the root, forming a cavity in the center. This larva is 23 mm long and 7 mm wide. The head is brown with strong black mandibles. There are 13 segments in the grayish white body. Neither abdominal nor thoracic legs are present which suggests the possibility of this insect being a coleopterous borer.

Results of the study indicate the first described larva is the most effective insect associated with (Echinacea angustifolia). Seed counts made in June and July of heads of the previous season indicate that 47 per cent of the seeds in each head had been destroyed. The damage might have been even greater but for the fact that some of the larvae had died sometime during the winter. On June 10 one hundred fifty-four stalks of the previous season were gathered from the field. Of these 105 had emergence holes indicating infestation. There were no seeds left on these heads.

RATIBIDA COLUMNARIS (SIMS) T-G

The tall headed cone flower,(Ratibida columnaris) is one of the most prominent forbs throughout the mixed prairie area. It seems to be more suscentible to damage by insects attacking from without than by such as affect it from within. In one count,made on August 7, every one of 42 heads showed external damage but none bore indications of internal infestation. On 43 stems 335 heads were carefully dissected. Only one insect was found to inhabit the stems and roots as a borer. This insect was found in the larval form drilling downward in the stem in two plants and in the root of a third. The stems were kept and from them Polynema bifasciatipennis (Gir.) appeared. Since all of the species of Polynema listed by Essig (7) are parasitic either upon eggs or larvae of other insects the identity of the borer itself is still to be ascertained. As before mentioned in the discussion of(L.punctata)the same small Chalcid was found in (R.columnaris) as described in the previous discussion.

One plant of (Ratibida columnaris)was found in which the main stem was broad and flat,being about one half inch wide and ending in a fan-shaped head 2 inches wide at the top. Dissection revealed no internal insects except the egg-like structures of the small Chalcid. The plant was infested with ants which made their den among the roots.

Ten of the 26 heads were excessively broadened or dichotomous.

From the observations made in this study it would seem that (Ratibida columnaris) is little affected by insects that inhabit it.

HELIANTHUS ANNUUS L.

Perhaps the most commonly infested plant of this study has been found to be the annual sunflower,(Helianthus annuus),which has become a weedy nuisance throughout the area. In one count of 48 heads of this plant dissected 45 were found to contain one or more larvae and the others gave evidence of earlier infestation. Ten stems dissected at the same time showed every one burrowed by insects.

A total of 82 plants bearing 162 heads were dissected. These were collected from 4 different areas in Ellis County at Quinter,and at Lucas. From many additional plants separate parts were dissected. Seven different insects were reared from the heads,4 from the stems,and one species found in the roots was kept though not successfully cultured.

Among the insects discovered causing damage to the seeds a prominent one is the Angoumois grain moth,Sitotroga cerealella (Olivier). Essig (7) says this insect was introduced to America prior to 1743 and was first insect to be

discussed in an American scientific publication. The larva and pupa were discovered among the seeds in the head. Another lepidopteron which was found very commonly in the heads is probably Hellula undalis (Febr.). Two probable parasites of H. undalis also were cultured from the heads. Cremastus facilis (Cress.) appeared in a number of culture vials and another species of Ichneumonidae of the genus Angitia. Some of the Angitia are listed by Essig (7) as parasites of H.undalis. Three other Lepidoptera obtained from the heads of (H.annuus)are one that may be of the Tineidae,a species of Homeosoma,and a species of Phycitidae. An Inhneumon found in association with them is a species of Macrocentrus. Whether or not this specimen is parasitic upon either of the foregoing remains to be ascertained.

Among the insects inhabiting the stems the largest found was a coleopteron,Rhodobaenus tredecimpunctatus (Illiger). Tucker (14) lists this coleopteron as commonly found on the sunflower but makes no mention of its breeding inside the plant. Schwitzgebel and Wilbur (12),who found this species on(V.interior)(syn.baldwini),quote Blatchley and Leng (13) as stating that the insect breeds in many(Compositae) including the sunflower. The specimen in the present study was discovered on August 2,1941 as a pupa located in the root of the plant. A burrow had been dug from a place

about 30 inches above the surface of the ground down to the root. The pupa lay at the bottom of this burrow. The adult emerged on August 5. Another inhabitant of the stem, Agromyza virens (Loew) was found in the pupal stage in the transition zone near the surface of the ground. On June 20, 1942 the pupa was discovered in a plant which was swollen at this point and a crack in the cortex seemed to indicate an open gall. The gall very closely resembles that of the Grapevine wound gall, made by the stimulation of Baridius sesostris (Le Conte)(11). This insect is listed by Essig(7) as one of the stem miners. In the present case the mine was somewhat deep, leading to the tentative classification as a stem borer.

At Quinter, Kansas another lepidopteron was found very commonly inhabiting the leaf petioles and pupating usually in the axil, where an exudation formed a sticky mass which was easily detected. This insect is a species of Olethreutidae, probably Suleima heliantha (Riley). It was taken in considerable numbers on August 7. This insect was not collected in any other location.

The largest dipteron taken from (Helianthus annuus) is probably a species of the Dexiidae which pupated in the stem about one half inch below the basal disk. The pupal case was dark red, 5 mm long and 1.5 mm in diameter. The adult emerged on July 7, 1942.

A coleopteron was found commonly burrowing in the root. This insect collected in the larval stage was not successfully cultured. It is a whitish grub 8 mm long and 3 mm in diameter. The body has 12 segments without either prolegs or thoracic legs. The body is thickest at the middle, tapering toward both ends. It is probably a Curculio.

In view of the fact that so many insects infest the various parts of (Helianthus annuus) it is difficult to estimate the damage done by an individual species except in relation to its frequency of occurrence. The most commonly occurring among all were the Sitotroga cerealella and the Hellula undalis one or both of which occurred in 63.3 per cent of the heads.

GAILLARDIA PULCHELLA FOUG.

The showy gaillardia, (Gaillardia pulchella) Foug., one of the gaudiest flowers of the prairie, is commonly found in sandy areas of western Kansas. It sometimes becomes so numerous that hillsides may be red-brown with its colors for miles. This plant is perhaps one of the most attractive to insect visitors. Inside however few insects were encountered. The most effective destroyer of the seeds seemed to be a lepidopteron species of the subfamily Phycitidae. The larva of this insect was commonly found within the head from June 20 to August 5. It is 16 mm

in length. The ground color is yellow with five brownish stripes extending the length of the body. Each of the 11 segments except 2 and 3 bears a dark spiracle spot on each side. Segments 6 to 9 are provided with prolegs. The head is pale brown.

The larva commonly draws the ligules down over the central disk by means of silken threads and attaches them in this position forming a canopy under which to feed on the developing seeds. This canopy prevents the spreading pappus of the ripening seeds from pushing away from the basal disk. When ready to pupate the larva at times was found to drill down through the basal disk into the stem from which an emergence hole was made from 1 to 3 inches below the head. The part of the plant infested by this insect died and became hard and dry. The insect then pupated in a cocoon spun among the remnants of the seeds. The pupa measures 8 mm in length.

The same insect was reared from the disk flowers of (H.annuus). The adult in this case emerged August 2. In another case this insect was found parasitized by Cremastus facilis (Cress.) which emerged on August 8.

BOEBERA PAPPOSA VENTENAT

The fetid marigold,(Boebera papposa) is an ill-scented annual found commonly in disturbed areas of the

prairie. From the college pasture 25 plants were dissected during the month of August 1941. The 275 heads carefully examined yielded no insects. From the banks of the Saline River north of Gorham 10 plants were collected on August 5. Dissection showed these also to be entirely free from insect infestation. On August 7 18 additional plants were taken at Quinter. On November 7 another sampling of 12 plants was taken from the college pasture. Of the total number of 65 plants dissected only 4 showed indications of infestation and in one case only was a minute larva found. This larva desiccated soon after discovery.

LYGODESMIA JUNCEA PURSH

Among the forbs of secondary importance in the short grass area as well as in the little blue stem habitat we find the skeleton weed (Lygodesmia juncea)according to Albertson (1).

At Hays 62 plants of this species were collected on August 12,1941, June 8 and July 3,1942. The 10 plants selected from a group of about 30 on August 12,1941 bore 147 pea-shaped galls from which Antistrophoplex bicoloripes (Cwfd) were reared. Felt (8) lists Aylax pisum (Walsh),a cynipid,as occupant of a pea-like gall on this plant, but later revises the name (9) listing it as Antistrophus which conforms to the original description by

Walsh (11). On August 12,1941 a root gall (Fig.13) was collected near Science Hall on the Fort Hays College campus. This gall was kept and when examined early in May 1942 showed no signs of life but when it was again examined on June 1,1942 it was found that 12 specimens of Antistrophus pisum had emerged. All of these were dead when discovered. For a comparison of the galls see Figures 13 and 15.

On August 5,1941 another type of gall was discovered on the banks of the Saline River north of Ellis. From 8 plants 17 of these galls were collected. From them (Fig.11, 12,and 14) another wasp,Eupelmus allynii (Fr.) was reared. Packard (10) made a detailed study of the life cycle of this insect and its relation to the Hessian fly,Mayetiola destructor (Say). He lists E.allynii as one of the most important parasites of the Hessian fly. Since this is a known parasite of other forms it is probable that the gall in this case was produced by another insect of which unfortunately we have not obtained a specimen.

Neither of the galls observed on this plant seemed appreciably to affect the plant. No other insects were detected in any other part of the plant.

SITILIAS GRANDIFLORA (NUTT.) GREENE

The false dandelion,(Sitilias grandiflora) is of only local importance on the prairie being generally rather sparsely distributed. But 7 plants were collected on June

6,1942 as they were obtained only a day before the area was mowed. A gall wasp affects the stems and petiole crowding as many as 17 galls into one and one fourth inch of the stem in one case. As a result the stems are commonly deformed but the galls did not seem to interfere with blooming and seed production (Fig.17).

The pale yellow pupa is 5 mm in length. The adult is 3 mm in length and of a dull non-metalic black color. The enlarged hind coxa suggests a member of the Eurytomidae.

SUMMARY

In this study 15 native prairie plants have been examined as collected from 15 areas in western Kansas. These were found to be hosts to a large population of insects. Of these 52 were studied. The rate of infestation was found to vary from .45 to 68 per cent. Several insects were found effective checks of their host plants, while the majority seemed to exert little effect upon them. The distribution of the insects was found to vary from a single area to eight locations as widely separated as Phillipsburg, Quinter, Hoxie, and Ness City.

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APPENDIX

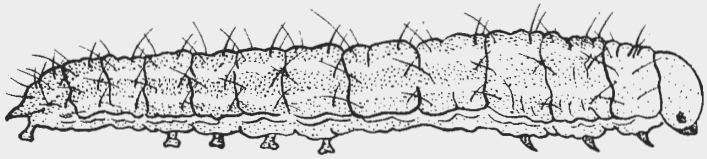


Fig. 1.

Fig. 2

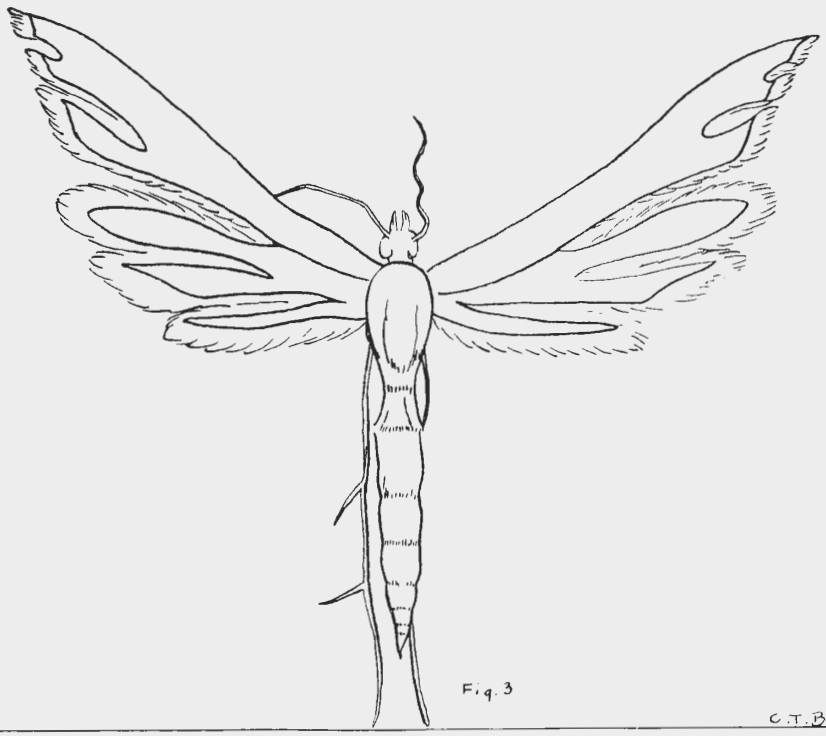
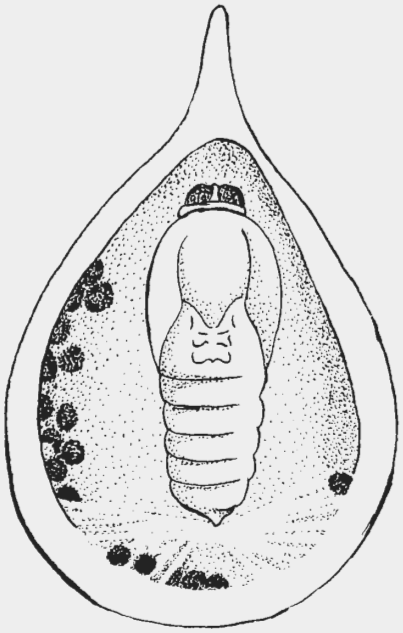


Fig. 3

C.T.B.



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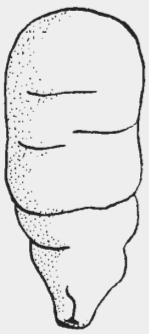

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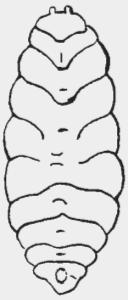

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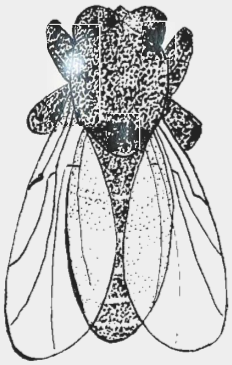

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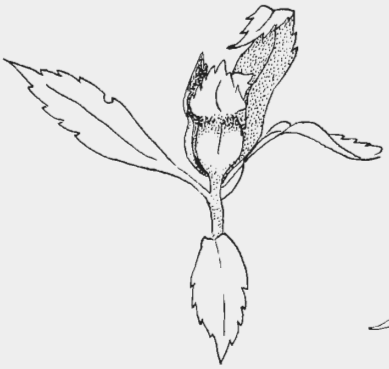
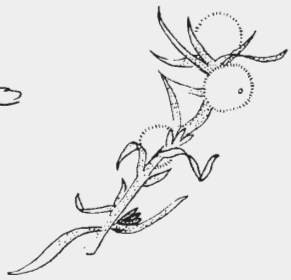


Fig 8



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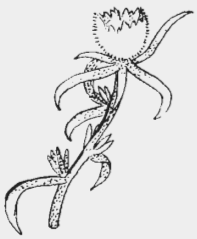

Fig. 10

Fig. 11

C.T.B.

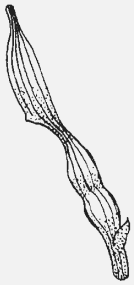

Fig. 12

Fig. 14

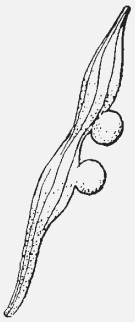

Fig. 16

Fig. 13

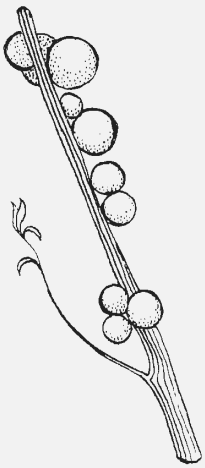

Fig. 15

Fig. 17

C.Y.B.

Plate 1.

Plate 2

Plate 3.

Plate 4.

Plate 5.

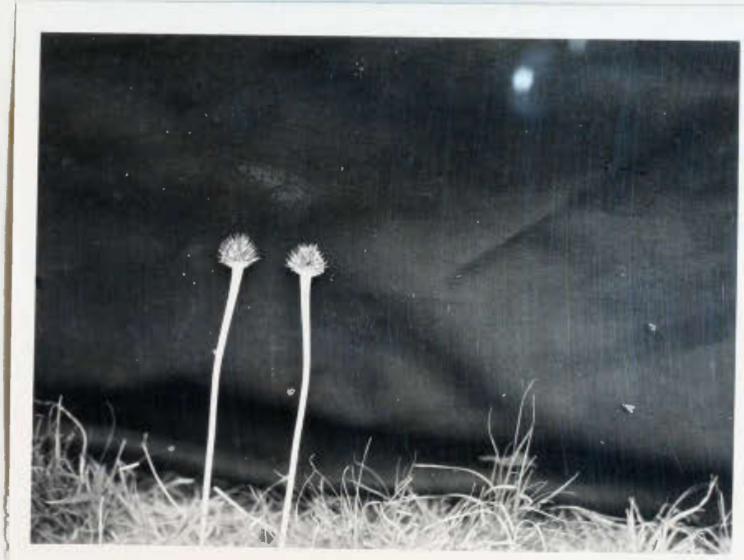

Plate 6.